solaR: radiación solar y sistemas fotovoltaicos con R

Oscar Perpiñán Lamigueiro

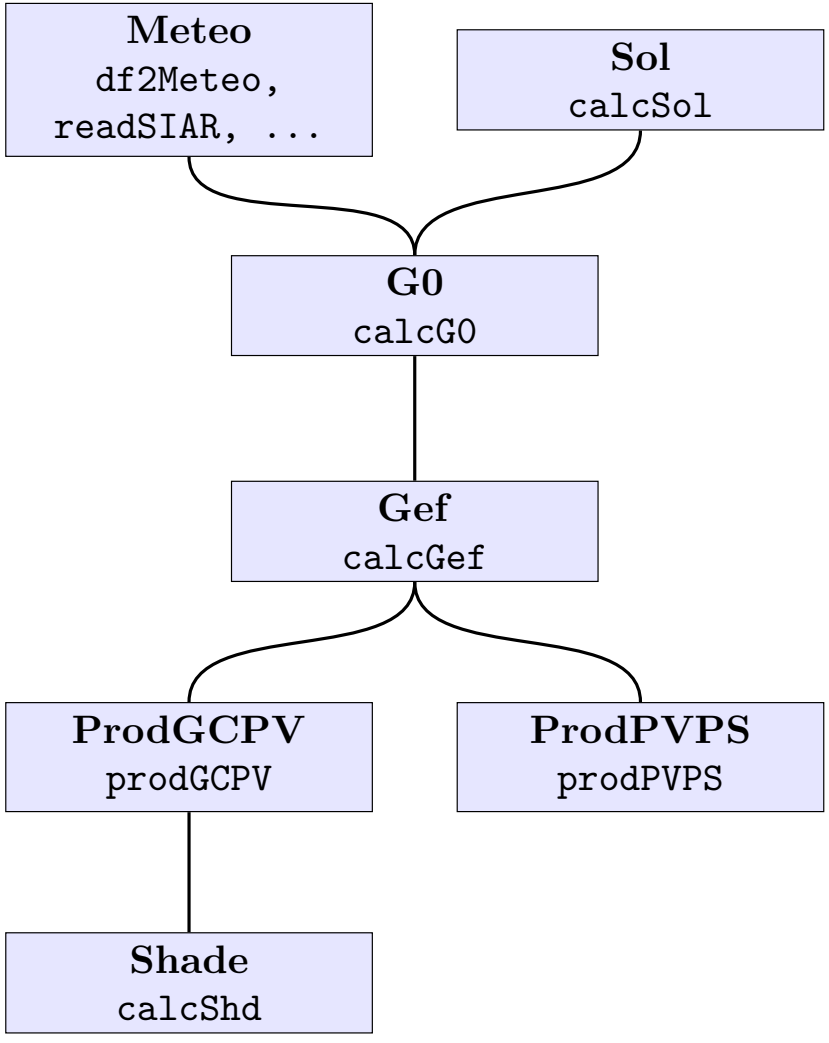
http://solar.r-forge.r-project.org

17 de Noviembre de 2011

Introducción

- Desde la geometría solar, pasando por la irradiación efectiva en un plano hasta la productividad de un sistema fotovoltaico.
- Clases y métodos S4.
- `zoo` para construir series temporales multivariantes.
- `lattice` y `latticeExtra` para métodos de visualización.

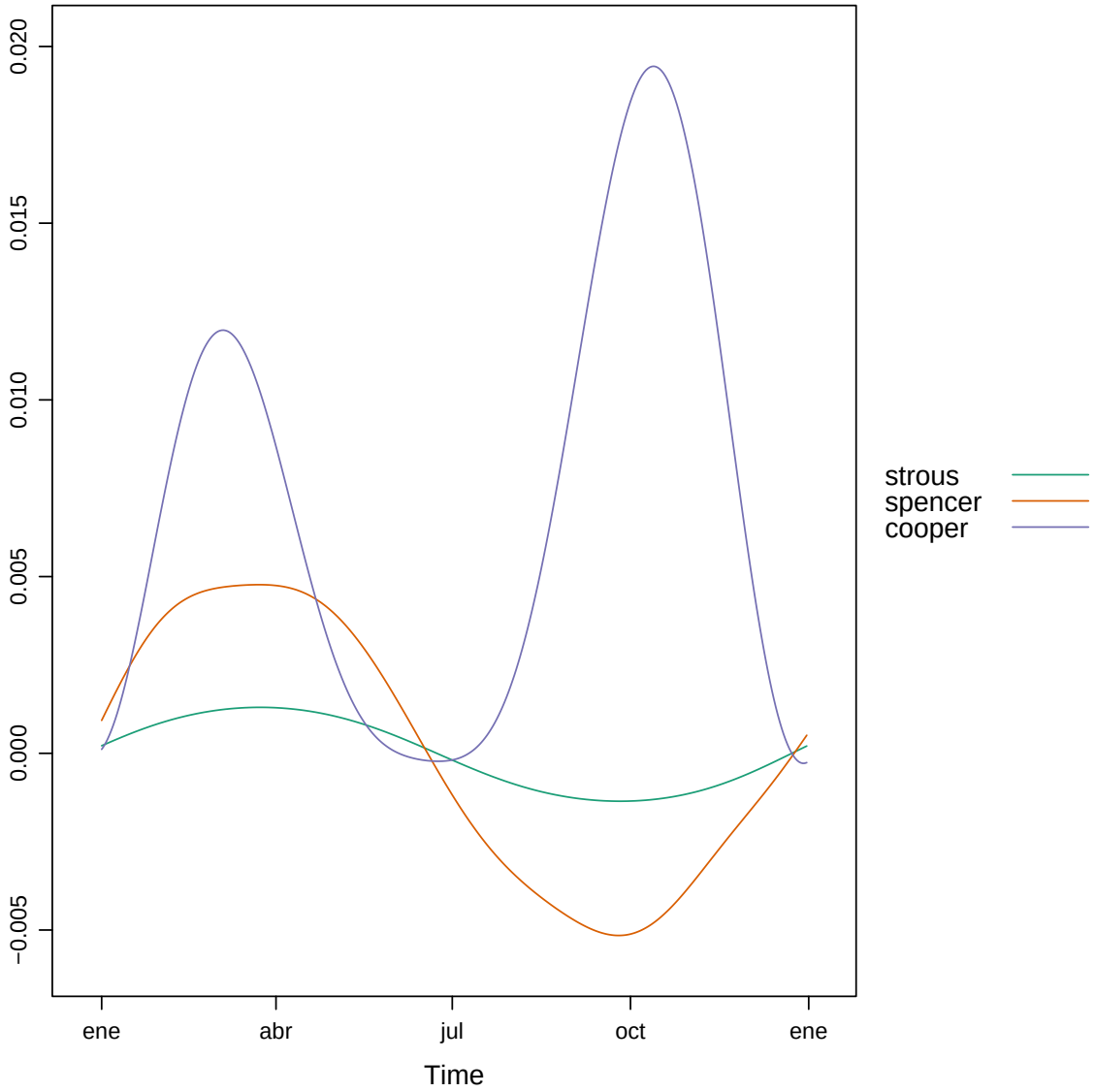
Clases


Meteo
df2Meteo,
readSIAR, ...
Sol
calcSol
G0
calcG0
Gef
calcGef
ProdGCPV
prodGCPV
ProdPVPS
prodPVPS
Shade
calcShd

Geometría solar

```
> lat = 37.2
> BTd = fBTd(mode = "serie")
> solStrous <- fSolD(lat, BTd, method = "strous")
> solSpencer <- fSolD(lat, BTd, method = "spencer")
> solCooper <- fSolD(lat, BTd, method = "cooper")
> solMichalsky <- fSolD(lat, BTd,
    method = "michalsky")
> decDif <- solMichalsky$decl - cbind(solStrous$decl,
    solSpencer$decl, solCooper$decl)
> names(decDif) <- c("strous", "spencer",
    "cooper")
```

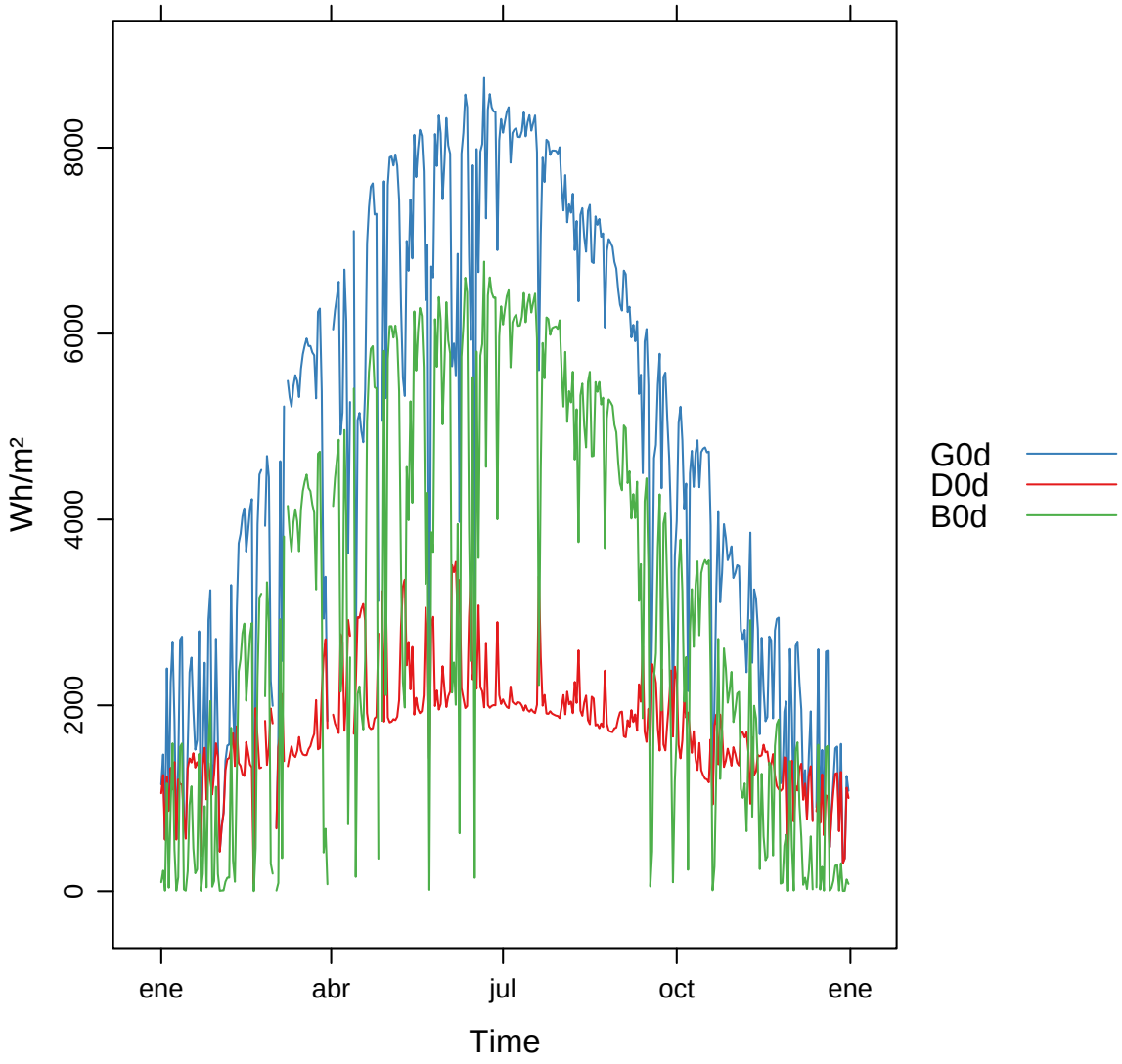
Geometría solar



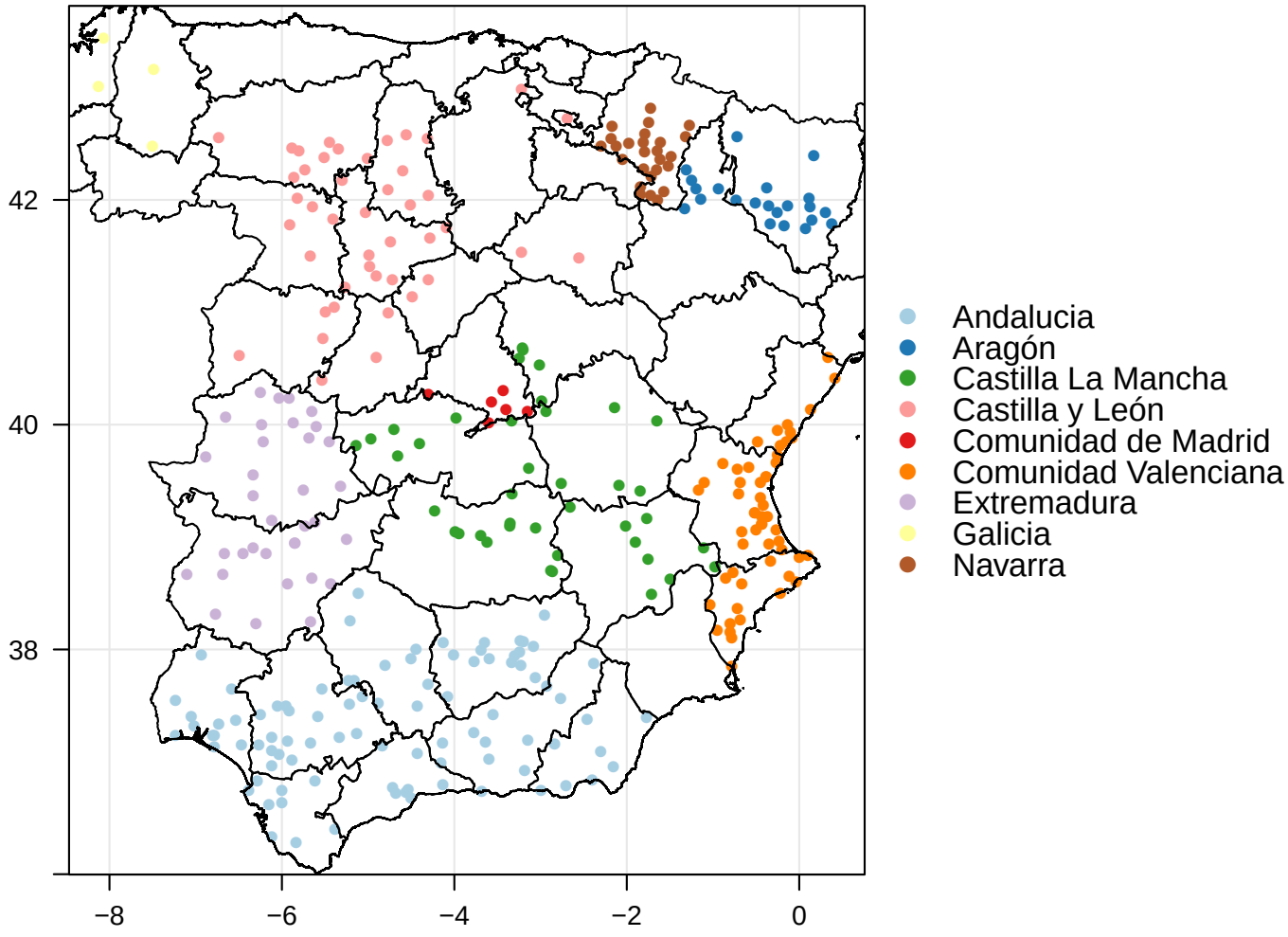
Radiación solar en el plano horizontal

```
> g0 <- calcG0(lat = 37.2, modeRad = "siar",
      dataRad = list(prov = 28, est = 3,
          start = "01/01/2009", end = "31/12/2009"))
```

Radiación solar en el plano horizontal



SIAR

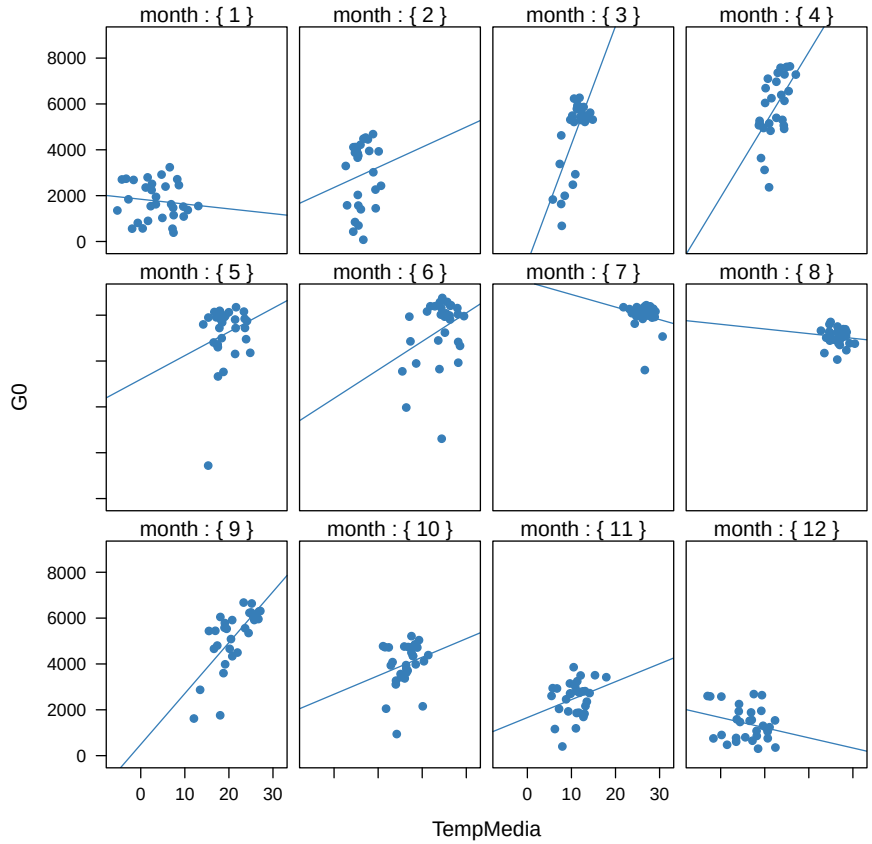


http://www.marm.es/siar

http://solar.r-forge.r-project.org/data/SIAR.csv

SIAR

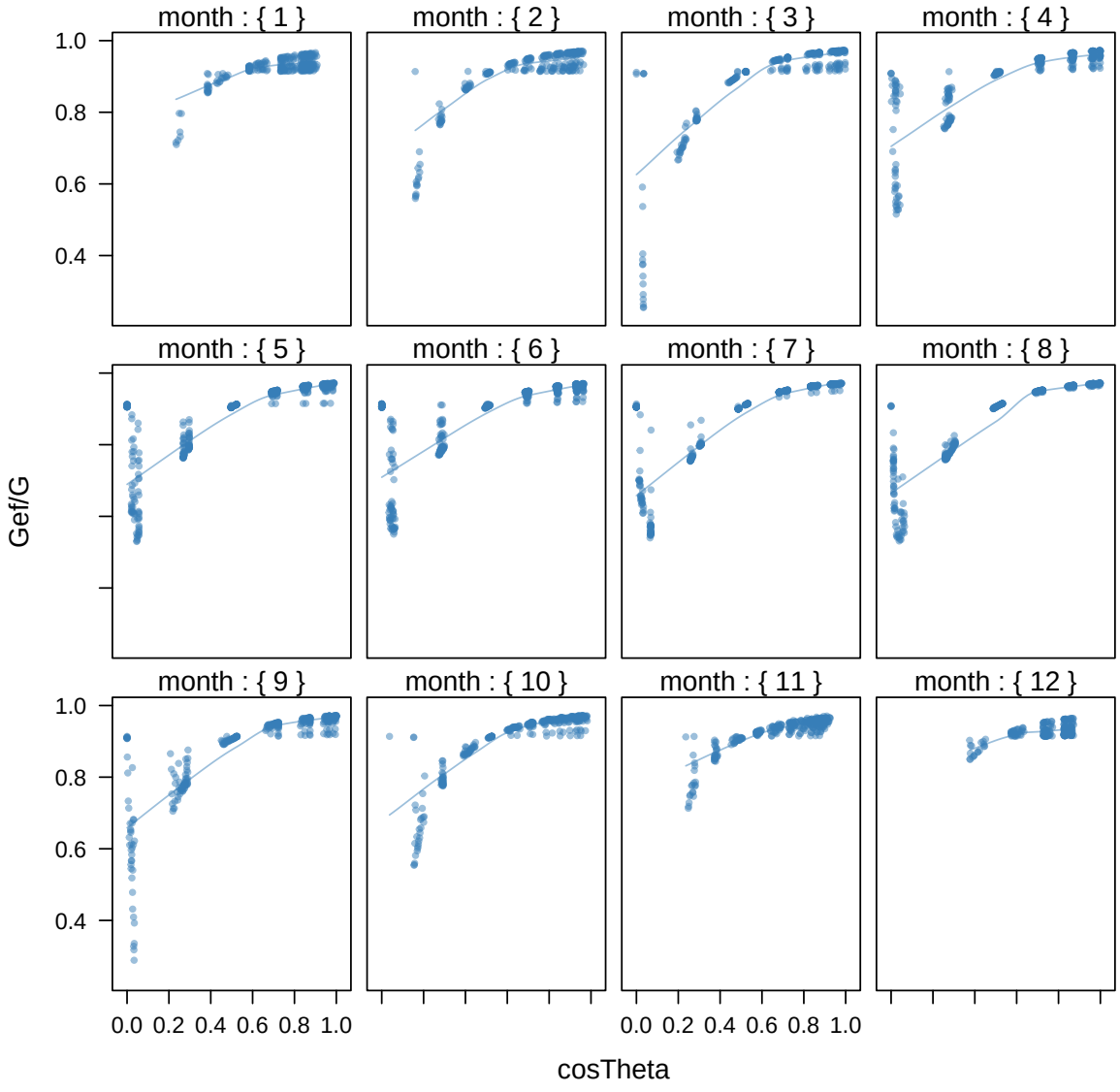
```
> Aranjuez <- readSIAR(28, 3, "01/01/2009",
      "31/12/2009")
```



Radiación solar en un plano inclinado

```
> g0 <- calcG0(lat = 37.2, modeRad = "siar",
     dataRad = list(prov = 28, est = 3,
         start = "01/01/2009", end = "31/12/2009"))
> gef <- calcGef(lat = 37.2, modeRad = "prev",
     dataRad = g0, beta = 30)
> xyplot(Gef/G ~ cosTheta | month,
     data = gef, type = c("p", "smooth"),
     cex = 0.4, alpha = 0.5)
```

Radiación solar en un plano inclinado



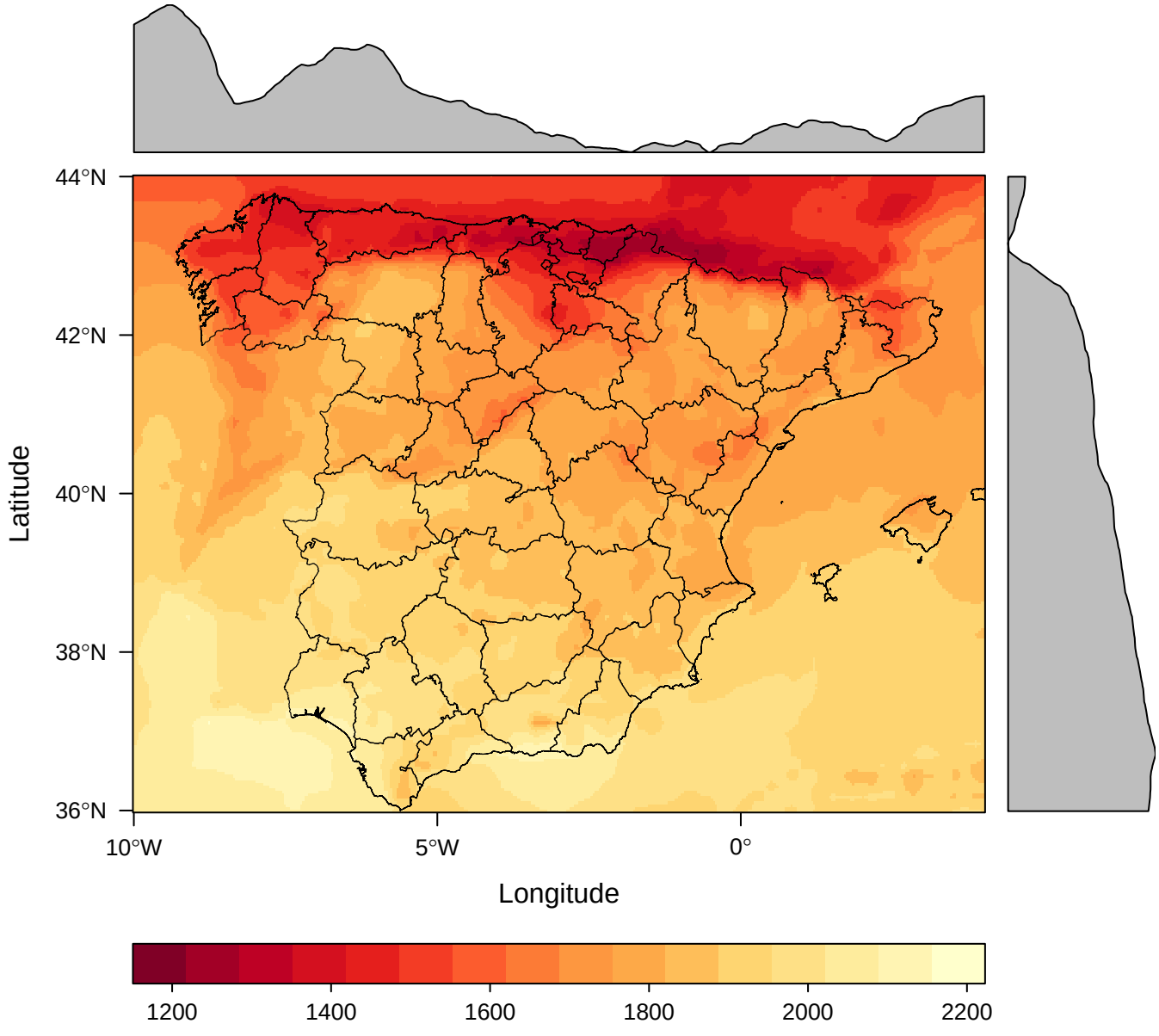
Radiación solar en un plano inclinado

solaR y raster

```
> library("raster")
[...]
> foo <- function(x, ...) {
      gef <- calcGef(lat = x[1],
          dataRad = list(G0dm = x[2:13]))
      result <- as.data.frameY(gef)[c("Gefd",
          "Befd", "Defd")]
      as.numeric(result)
 }
> latLayer <- init(SISmm, v = "y")
> gefS <- calc(stack(latLayer, SISmm),
      foo, filename = "CMSAF/gefCMSAF",
      overwrite = TRUE)
```

Radiación solar en un plano inclinado

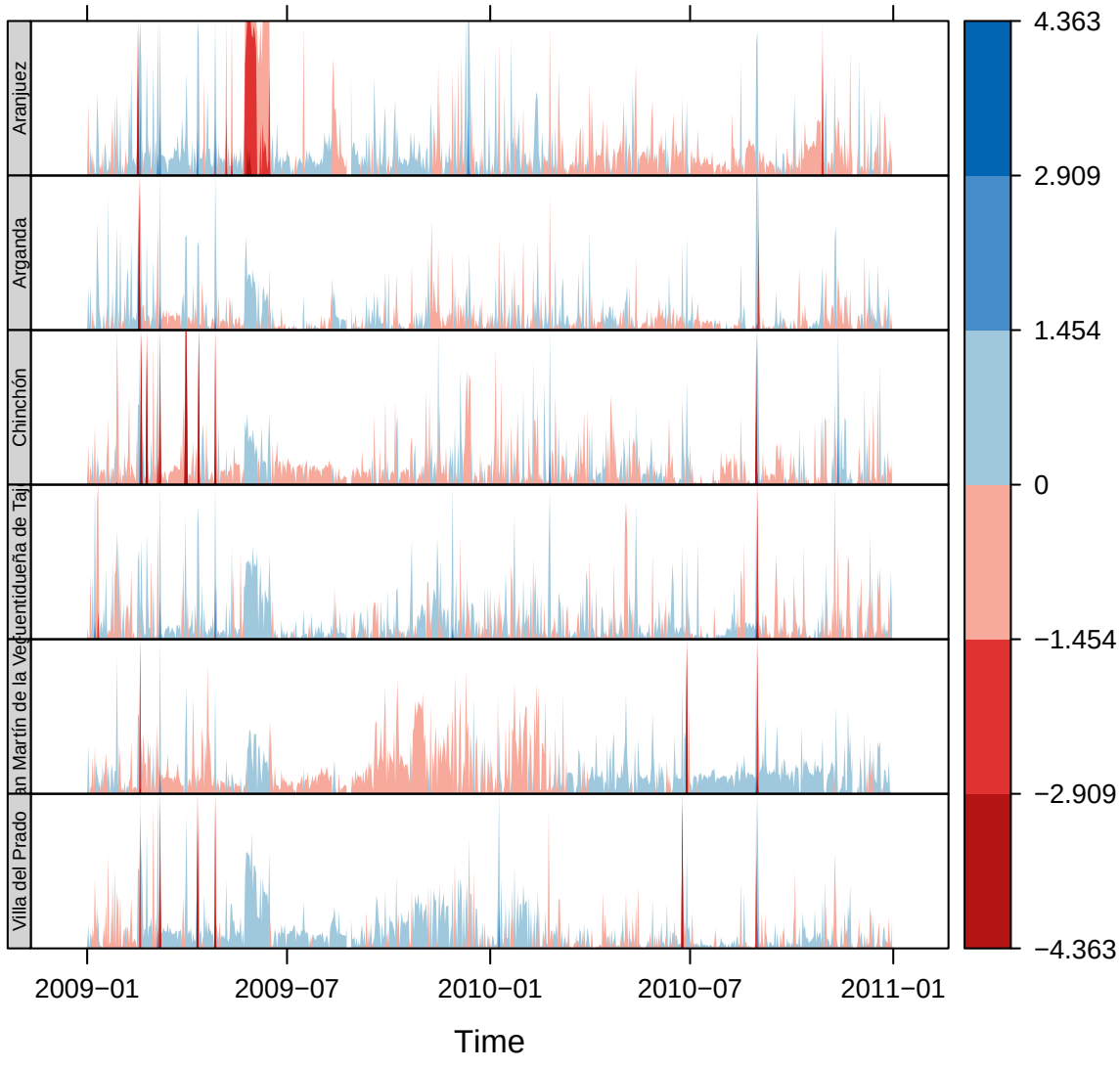
solaR y raster



Productividad de un SFCR

```
> EstMadrid <- subset(SIAR, Provincia == "Madrid")
> nEstMadrid <- nrow(EstMadrid)
> namesMadrid <- EstMadrid$Estacion
> prodMadrid <- lapply(1:nEstMadrid, function(x) {
      try(prodGCPV(lat = 41, modeRad = "siar",
          dataRad = list(prov = 28, est = x,
          start = "01/01/2009", end = "31/12/2010")))
 })
> names(prodMadrid) <- namesMadrid
> okMadrid <- lapply(prodMadrid, class) != "try-error"
> prodMadrid <- prodMadrid[okMadrid]
> YfMadrid <- do.call(mergesolaR, prodMadrid)
```

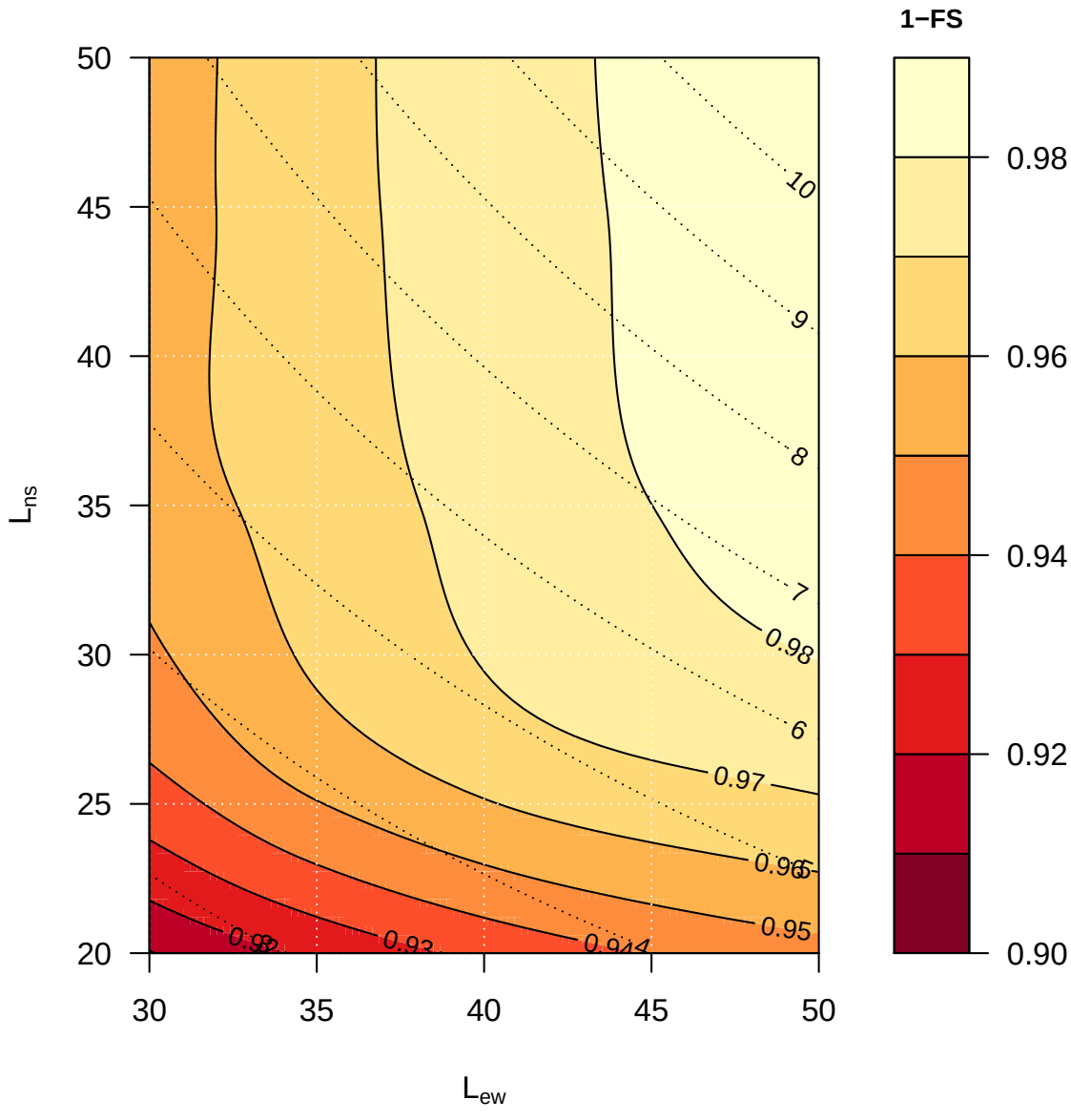
Productividad de un SFCR



Sombras en un SFCR

```
> struct2x = list(W = 23.11, L = 9.8,
     Nrow = 2, Ncol = 8)
> dist2x = list(Lew = c(30, 50),
     Lns = c(20, 50))
> ShdM2x <- optimShd(lat = lat, dataRad = prom,
     modeTrk = "two", modeShd = c("area",
         "prom"), distances = dist2x,
     struct = struct2x, res = 5,
     prog = FALSE)
> shadeplot(ShdM2x)
```

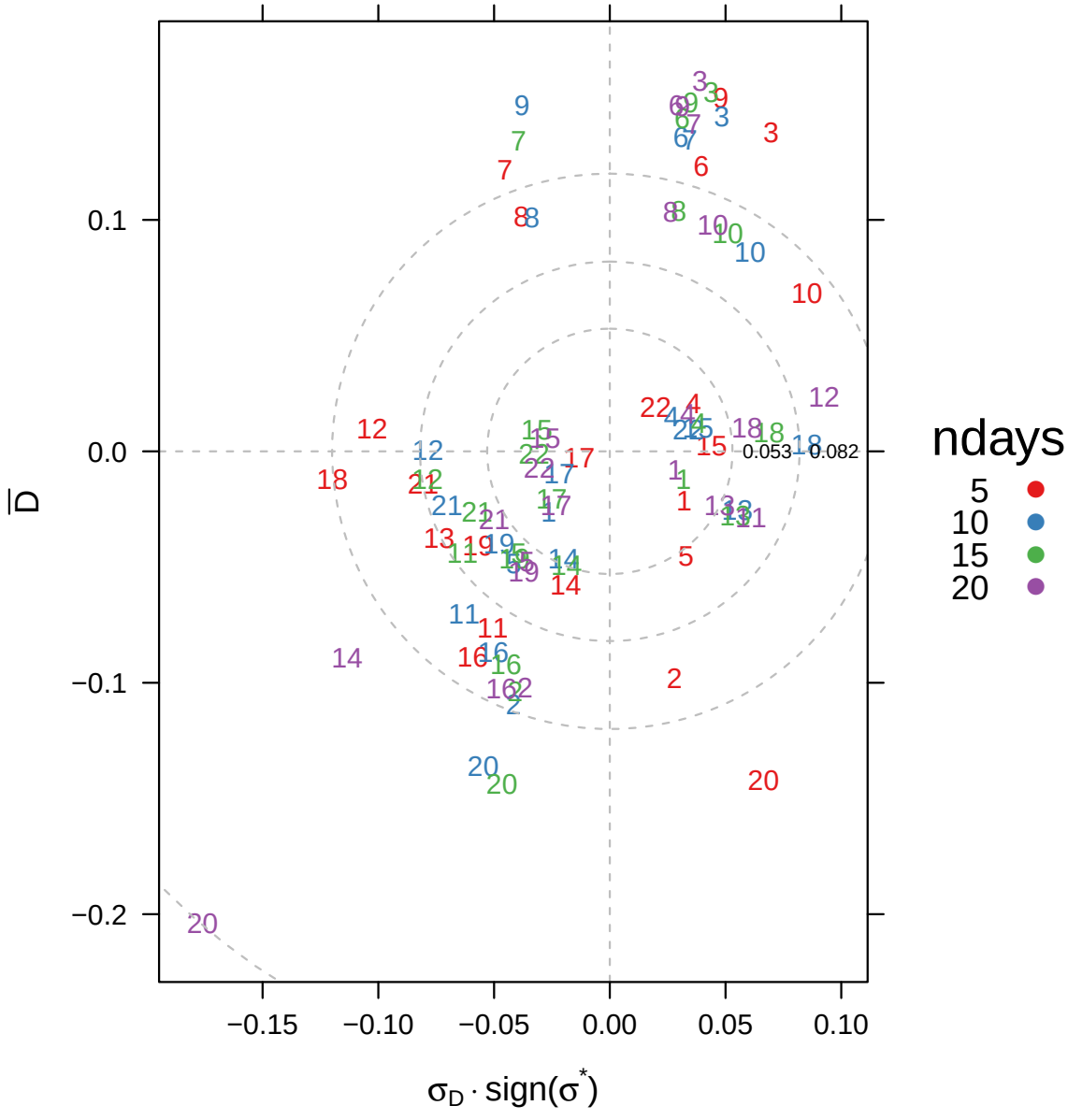
Sombras en un SFCR



Target Diagram

```
> data("prodEx")
> ndays = c(5, 10, 15, 20)
> palette = brewer.pal(n = length(ndays), name = "Set1")
> TDColor <- TargetDiagram(prodEx, end = day,
      ndays = ndays,
      color = palette)
```

Target Diagram



Bibliografía I

[1] Jolliff, J.; Kindle, J. C.; Shulman, I.; Penta, B.; Friedrichs, M. A. M.; Helber, R. y Arnone, R. A.: ■Summary Diagrams for Coupled Hydrodynamic-Ecosystem Model Skill Assessment■. *Journal of Marine Systems*, 2009, **76**, pp. 64–82.

[2] Perpiñán, O.: ■Statistical Analysis of the Performance and Simulation of a Two-Axis Tracking PV System■. *Solar Energy*, 2009, **83(11)**, pp. 2074–2085. ISSN 0038-092X. doi: 10.1016/j.solener.2009.08.008.

[3] ——: ■CMSAF, SIAR and R■, 2011. Incluido en un Proyecto de Fin de Máster de la EOI. https://r-forge.r-project.org/scm/viewvc.php/drafts/kriging.R?view=markup&root=solar

[4] ——: *Energía Solar Fotovoltaica*, 2011. http://procomun.wordpress.com/libroesf

Bibliografía II

[5] Perpiñán, O. y Lorenzo, E.: ■Analysis and Synthesis of the Variability of Irradiance and PV Power Time Series with the Wavelet Transform■. *Solar Energy*, 2011, **85(1)**, pp. 188 – 197. ISSN 0038-092X. doi: DOI:10.1016/j.solener.2010.08.013.

[6] Sarkar, D.: *Lattice: Multivariate Data Visualization with R*. Springer, New York, 2008. ISBN 978-0-387-75968-5. http://lmdvr.r-forge.r-project.org

[7] Sarkar, D. y Andrews, F.: *latticeExtra: Extra Graphical Utilities Based on Lattice*, 2010. R package version 0.6-12/r148. http://R-Forge.R-project.org/projects/latticeextra/

[8] Taylor, K. E.: ■Summarizing Multiple Aspects of Model Performance in a Single Diagram■. *Informe técnico*, 2000. http://www-pcmdi.llnl.gov/publications/pdf/55.pdf

Bibliografía III

[9] Ummel, K.: *SEXPOT: A Spatiotemporal Linear Programming Model to Simulate Global Deployment of Renewable Power Technologies*. Tesina o Proyecto, Central European University, Budapest, 2011.
http://dl.dropbox.com/u/14314000/ThesisMedia/Kevin_Ummel_CEU_2011.pdf

[10] Zeileis, A. y Grothendieck, G.: ■zoo: S3 Infrastructure for Regular and Irregular Time Series■. *Journal of Statistical Software*, 2005, **14(6)**, pp. 1–27.
http://www.jstatsoft.org/v14/i06/